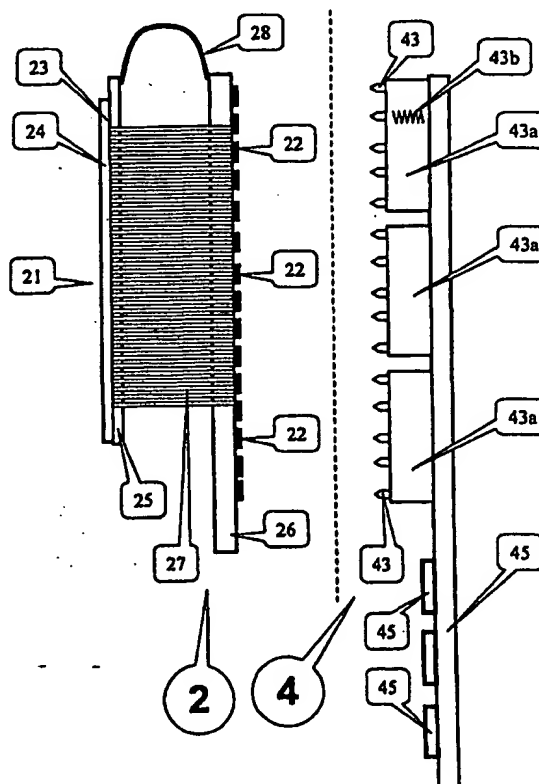


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**(57) Abstract**

Liquid crystal display (LCD) apparatus, includes an LCD-based sign (2) in which the LC display elements have an inherent memory. The LCD-based sign also includes a plurality of contact pads (22), and a plurality of electrically-conductive pathways connecting the contact pads to the LC display elements. The electronic drivers are carried by a separate programming unit having a holder for removably receiving, and holding an LCD-based sign to be programmed, an input device for selecting the LC display elements to be energized, and a plurality of pins (43) to be brought into contact with the plurality of pads of an LCD-based sign held by the holder for selecting the LC display elements to be energized.



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## LCD APPARATUS AND METHOD OF PRODUCING DESIRED DISPLAYS USING SUCH APPARATUS

### FIELD AND BACKGROUND OF THE INVENTION

The present relates to LCD (liquid crystal display) apparatus, and also to  
5 a method of producing desired displays using such apparatus. The invention is particularly useful with respect to signs that have to be infrequently changed or updated, such as name tags, street signs, highway markers, door signs, floor directories, price tags, short product description signs, and the like, and the invention is therefore described below with respect to such applications.

10 Many different types of electronic devices, such as those based on CRT and gas-plasma techniques, are now widely used for producing signs or other types of displays requiring continuous or frequent change, or the capability of instant updating. However, such displays are expensive to produce and to maintain, and are therefore not suitable for many applications. LC (liquid crystal)  
15 devices are increasingly being used for low-cost displays of this type, but even LC displays are costly to produce and to maintain. This is primarily because the LCD devices presently being used generally include, an electronic driver for each display element in order to selectively refresh the display elements. Thus, electronic displays in general, and LCD devices in particular, are presently not  
20 used for simple, low-cost displays, such as those set forth above, which are not frequently changed or updated.

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## OBJECTS AND SUMMARY OF THE INVENTION

An object of the present invention is to provide LCD apparatus which can be used for producing low-cost LCD devices, particularly those requiring infrequent change or updating. Another object of the invention is to provide a method of producing displays using such LCD apparatus. A further object of the invention is to provide low-cost LCD-based signs requiring for applications not frequent change or instant updating; and a still further object of the invention is to provide a separate programming unit which may be used for changing or updating the LCD-based signs when needed.

According to one broad aspect of the present invention, there is provided LCD apparatus, comprising: a plurality of liquid crystal (LC) display elements carried by an LCD member and selectively energizable to produce a desired display, and electronic drivers actuatable to selectively energized the LC display elements to produce the desired display; characterized: in that the LCD member includes LC display elements having an inherent memory, the plurality of LC display elements on the front face thereof, a plurality of contact on another face thereof, and a plurality of electrically-conductive pathways connecting the contact pads to the LC display elements; and in that the electronic drivers are carried by a separate programming unit having a holder for removably receiving and holding an LCD member to be programmed, an input device for selecting the LC display elements to be energized, and a plurality of pins to be brought into contact with the plurality of pads of an LCD member when received on the holder for selecting the LC display elements to be energized.

According to the preferred embodiment described below, the LCD member is a polymer-based LCD panel having an inherent non-volatile memory, and assembled with a printed circuit board having a plurality of contact pads for selectively energizing the display elements. A number of LCD panels having memory have recently being developed and are described in the literature. The use of such panels enables the electronic driver circuitry, required for refreshing or updating the displays, to be removed from the LCD panels and to be included in the programming unit, thereby substantially decreasing the overall cost of the

display devices while still enabling such devices to be updated as and when required.

According to still further features in the described preferred embodiment, the back face of the LCD panel includes a printed circuit board having an inner face facing the LCD display elements, and an outer face carrying the contact pads. The outer face of the printed circuit board includes a first group of terminals electrically connected by conductive pathways on the outer face to some of the pads; and the inner face of the printed circuit board includes a second group of terminals electrically connected by plated-through holes to the remaining pads. The pads are arranged in a two-dimensional matrix on the back face. The first group of terminals on the outer face of the printed circuit board are electrically connected to corresponding terminals of the LCD display elements by a first plural-line heat-seal connector strip; and the second group of terminals on the inner face of the printed circuit board are electrically connected to corresponding terminals of the LCD display elements by a second plural-line heat-seal connector strip.

As will be described more particularly below, the foregoing features produce a compact two-dimensional array of pads to enable selective energization of the large number of terminals leading to the large number of display elements required for a high-resolution display panel.

According to another aspect of the present invention, there is provided a method of producing a desired display with LCD apparatus, comprising: providing an LCD member with a plurality of LC display elements having an inherent memory on the front face of the member, and with a plurality of contact pads on another face of the member, each contact pad being electrically connected to one of the LC display elements; bringing the contact pads into contact with a plurality of pins of a programming unit having a holder for removably receiving the LCD member, and electronic drivers for energizing the LC display elements; and selectively energizing the pins via the electronic drivers to select the LC display elements to be energized to produce a desired display of the information.

According to a still further aspect of the invention, there is provided an LCD-based sign including a plurality of LC display elements having inherent



memory on its front face, and a plurality of contact pads on its back face, each contact pad being electrically connected to one of the display elements to permit the display elements to be selectively energized by drivers in an external programming unit for producing a desired display on the front face.

5           According to a still further aspect of the invention, there is provided a programming unit for programming an LCD-based sign panel having a plurality of selectively-energizable display elements on its front face, and a plurality of pads on its rear face, each pad being electrically connected to one of the display elements for energizing same; the programming unit comprising: a holder for  
10   removably receiving and holding an LCD-based sign to be programmed; an input device for selecting the display elements to be energized of the LCD-based sign held in the holder; and a plurality of pins to be brought into contact with the plurality of pads on the rear face of the LCD-based sign when received in the holder for selecting the display elements thereof to be energized.

15           Further features and advantages of the invention will be apparent from the description below.

## BRIEF DESCRIPTION OF THE DRAWINGS

The invention is herein described, by way of example only, with reference to the accompanying drawings, wherein:

Fig. 1 is a pictorial illustration illustrating one form LCD apparatus  
5 constructed in accordance with the present invention, including an LCD-based sign and a programming unit for programming the sign to produce a desired display;

Fig. 2 is pictorial view illustrating only the LCD-based sign shown in Fig. 1;

10 Fig. 3 is a diagrammatic view illustrating the manner in which the main components of the programming unit of Fig. 1 cooperate with the LCD-based sign of Fig. 1 to produce a desired display in the sign;

Fig. 4 illustrates the outer face of the printed circuit board in the LCD-based sign of Figs. 1 and 2, particularly showing the array of contact pads on  
15 the back face and some of the conductive pathways therefrom to the display elements of the sign;

Fig. 5 illustrates the inner face of the printed circuit board at the back of the sign, and the conductive pathways from the remaining pads on the outer face of the LCD-based sign to the display elements;

20 Figs. 6a-6e more particularly illustrate how the electrical connections are made from the contact pads to the display elements of the LCD-based sign to be programmed;

Fig. 7 diagrammatically illustrates the construction of the programming unit of Fig. 1;

25 Fig. 8 more particularly illustrates the main functional components in the programming unit 4; and

Fig. 9 illustrates the keyboard in the programming unit.

## DESCRIPTION OF A PREFERRED EMBODIMENT

Fig. 1 pictorially illustrates one form of LCD (liquid crystal display) apparatus constructed in accordance with the present invention. Such apparatus includes two main components: an LCD-based sign, generally designated 2 in Fig. 1, and more particularly illustrated in Fig. 2; and a programming unit, generally designated 4, for programming the LCD-based sign 2, i.e. for selectively energizing the display elements of the LCD-based sign to produce the desired display. As shown by the diagram of Fig. 3, the LC (liquid crystal) display elements of the LCD-based sign 2 are receivable via a window defined by a peripheral frame 20 on the front face 21 of the sign, and the rear face of the sign is provided with a plurality of contact pads 22 connected by electrically-conductive pathways to the LC display elements for selectively energizing them.

An important feature of the present invention is that the LCD-based sign 2 does not include the electric driver circuitry for energizing or refreshing the display elements of the sign to produce the desired display; rather, the electronic driver circuitry is included in the programming unit 4 to be used whenever an LCD-based sign is to be programmed to produce a desired display, or to be changed in order to update the display. In this manner, the cost of the LCD-based signs can be substantially reduced, while still retaining the capability of changing the display whenever desired.

The LCD-based sign includes a polymer-based LCD panel having an inherent non-volatile memory, which can therefore be constructed as a passive device devoid of a power supply. As indicated above number of such LCD panels have recently been described in the literature. As will be described below, such a panel is used for making an LCD-based sign by attaching, to its back face, a printed circuit board having an array of contract pads 22 enabling the LC display elements to be separately addressed.

As will be described more particularly below, the programming unit 4 includes a holder 41 for removably receiving and holding an LCD-based sign to be programmed as shown in Fig. 1. It also includes an input device, in this case a keyboard 42, for selecting the LC display elements to be energized; and a plurality of pins 43 (Fig. 3) to be brought into contact with the pads 22 of the LCD panel 2

received in the programming unit 4, for energizing the selected LC display elements in order to produce the desired display. The programming unit 2 further includes the electronic driver circuitry, shown at 44 in Fig. 3 and to be described more particularly below, which energizes the display elements of the LCD-based sign 2 via pins 43 of the programming unit 4, and the pads 22 on the back face of the display panel received in the programming unit.

The construction of the LCD-based sign 2 is more particularly seen in Fig. 3. Its display elements 23, which are selectively energized to produce the desired display, are sandwiched between two transparent plates 24, 25 assembled by peripheral frame 20, so as to be viewable via the front face 21 of the sign. Plates 24 and 25 are also formed with the electrically-conductive pathways leading to the LC display elements 23 for selectively energizing them.

The contact pads 22 on the rear face of the LCD-based sign 2 are formed by printed-circuit techniques on the rear face of a printed circuit board 26, assembled with plates 24, 25 by frame 20. The contact pads 22 are connected by two heat seal connector strips 27, 28, to the terminals of the electrically-conductive pathways in transparent panels 24, 25. After these electrical connections are made, the printed circuit board 26 and the transparent panels 24, 25 are assembled together by frame 20 with the heat seal connector strips 27, 28 folded in-between, to produce a flat panel in which the LCD display elements 23 are viewable at the front face of the panel, and the contact pads 22 are exposed at the rear face of the panel.

Fig. 4 illustrates the outer face 26a of printed circuit board 26 containing the contact pads 22. Most of these contact pads are connected by electrically-conductive pathways formed on printed circuit board face 26a and connected by heat seal connector strips 27 to the LC display elements 23 for selectively energizing those display elements. The remaining electrically-conductive pathways leading from contact pads 22 are formed on the inner face 26b of printed circuit board 26, shown in Fig. 5, and are connected by heat seal connector strip 28 to the remaining LC display elements 23.

In the example to be described below particularly with reference to Figs. 4 and 5, the LC display elements are arranged according to a rectangular matrix

of pixels arrayed in a plurality of vertical columns and horizontal rows. In the illustrated example, there are 204 vertical columns and 48 horizontal rows, each electrically connected to a contact pad 22. Thus, there are 252 contact pads 22 exposed on face 26a of the printed circuit board.

5           Each contact pad 22 is electrically connected via an electrically-conductive pathway to a terminal on the printed circuit board 26, which terminals are electrically connected to the LCD display elements 23. In order to accommodate this high number of terminals and conductive pathways from the contact pads 22 to their respective display elements, the terminals are divided into  
10   two groups: one group of terminals 29a are carried on the outer face 26a of printed circuit board 26 (Fig. 4), and are connected by heat seal connector strip 27 to the LC display elements 23; and the second group of terminals, shown as 29b in Fig. 5, are carried on the inner face 26b of printed circuit board 26, and are connected by heat seal connector strip 28 to the LC display elements 23.  
15   Terminals 29b on the inner face 26b of the printed circuit board 26 are in turn connected to their respective pads 22 on the outer face 29a of the printed circuit board by plated-through holes formed through the printed circuit board.

More particularly, and as shown in Fig. 4, the contact pads 22 are arranged in a two-dimensional matrix on the back face 26a of the printed circuit  
20   board 26. Actually, they are arranged in two such matrices interleaved with each other. Thus, one two-dimensional matrix of pads, generally designated 22a, includes 14 x 14 pads, totaling 196 pads; and the second two-dimensional matrix of pads, generally designated 22b, includes 14 x 7 pads, totaling 98 pads. However, only 56 of the latter pads 22b are connected to electrical terminals, such  
25   that the total number of active pads is 196 plus 56, totaling 252.

The electrical terminals are also divided into two groups: one group of terminals 29a (Fig. 4) are located on the outer face 26a of the printed circuit board 26; whereas the other group of terminals 29b (Fig. 5) are located on the inner face 26b of the printed circuit board.

30           In the illustrated example, there are 204 terminals 29a on face 26a, (Fig. 4); these are connected to the 196 contact pad 22a on face 26a, and only 28 of the contact pad 22b' on face 26a (these being in the two right-most vertical

columns in Fig. 4). Face 26b shown in Fig. 5 includes 48 terminals 29b; these are connected by plated-through holes in 48 of the contact pads 22b. Thus, as shown in Fig. 5, four of the terminals 29b in each of the six left-most vertical columns of contact pads 22b are connected via plated-through holes 22b' to their respective  
5 contact pads 22b (totaling 24); and three terminals 29b of the remaining eight vertical columns are connected to their respective contact pads 22b via plated-through holes 22b' (totaling another 24), for a total of 48 terminals on side 26b of the printed circuit board:

The 204 terminals 29a on side 26a of the printed circuit board 26 are  
10 connected by heat seal connector strips 27 (Fig. 3) to their respective LC display elements 23; and the 48 terminals 29b on the inner face 26b of the printed circuit board 26 are connected by heat seal connector strip 28 to their respective LC display elements 23.

The manner in which the heat seal connector strips 27 and 28  
15 electrically connect the contact pads 22 to the display elements 23 of the LCD-based sign is more particularly in Figs. 6a-6e.

As shown in Figs. 6a-6e (particularly in Figs. 6d and 6e), the front transparent panel 24 is used for addressing the horizontal rows of the display elements; and the back transparent panel 25 is used for addressing the columns  
20 of the display elements. Heat seal connector strip 27, used for making the column connections, is heat-welded at one end to the column terminals 29a on face 26a of the printed circuit board 26, and at the opposite end to the column terminals in the back transparent panel 25. Heat seal connector strip 28 used for making the row connections is heat-welded at one end to the row terminals 29b  
25 on face 26b of the printed circuit board 26, and at the opposite end to the row terminals in the front transparent panel 24. This is facilitated by the provision of a rubber spacer 30 (Figs. 6d, 6e) between the back transparent panel 25 and the back printed circuit board 26.

The front transparent panel 24, the back transparent panel 25, and the  
30 printed circuit board 26, with their respective terminals connected together by the two heat seal connector strips 27 and 28, are then all enclosed within the plastic frame 20, to provide the LCD-based sign having the display elements viewable

through the front window 21, and the contact pads 22 on the back face to enable selective energization of these display elements.

The above-described arrangement permits a large number of LC display elements to be selectively energized by a two-dimensional array of contact pads  
5 exposed on the outer face of the LCD-based sign, thereby enabling the construction of compact high-resolution LCD-based signs.

As indicated earlier, the programming unit 4 is used for selectively energizing the LCD elements 23, via the contact pads 22, in order to produce a desired display. Thus, the LCD-based sign 2 to be programmed is received within  
10 holder 41 of the programming unit 4. When the sign is programmed, the plurality of pins 43 (Fig. 3) of the programming unit are brought into contact with the contact pads 22 of the sign, and its display elements 23 are selectively energized via the keyboard 42 of the programming unit.

The pins 43, which are brought into contact with the contact pads 22 of  
15 the LCD-based sign 2 are carried by a printed circuit board 45. The same printed circuit board 45 may also be used for carrying the electronic drivers 44, as shown in Fig. 3; or the drivers 44 may be carried by a separate printed circuit board 46, as shown in Fig. 7, electrically connected by cable 47 to printed circuit board 45. In either event, printed circuit board 45 carrying the pins 43 is mounted on a  
20 carrier member, shown schematically at 48 in Fig. 7.

Carrier member 48 normally spaces the contact pins 43 from the pads 22 of the LCD-based sign 2, to permit insertion and removal of the sign. When it is desired to energize selected LC display elements 23, carrier member 48 is moved from its retracted inoperative position spacing the pins 43 from the pads  
25 22, to an operative position bringing the pins into contact with the pads. This movement of carrier member 48 from its normal retracted position to its operative position is effected by a lever 49 at one side of program unit 4. Lever 49 normally maintains pins 43 spaced from the pads 22, but is pivoted by the user to rotate an eccentric member 50 (Fig. 7) to move carrier member 48 to its operative position  
30 bringing the pins into contact with the pads.

As shown in Fig. 3, pins 43 are carried by a plurality of connector blocks 43a mounted on the printed circuit board 45, and are arranged in the form of a

rectangular matrix facing the contact pads 22 of the LCD based sign when received by the programming unit 4. Each pin 43 is spring-urged outwardly, by a spring shown schematically at 43b, to assure good contact with the pads when the printed circuit board 45 is moved by its carrier member 48 to its operative position.

As shown in Fig. 7, and more particularly in Fig. 8, the programming unit 4 includes, in addition to the keyboard 42, a main controller 50 including RS232 logic circuitry 51; a font memory 52; an LCD panel 53 to provide visual instructions to the operator; a display microcontroller 54; and the previously-described drivers 44 for selectively energizing the display elements of the LCD-based sign 2 to be programmed, via pins 43 of the programming unit 4 and the contact pads 22 of the sign 2. Programming unit 4 is preferably battery-operated, and therefore also includes a battery pack as shown at 55 in Fig. 7.

Keyboard 42 of programming unit 4 is more particularly illustrated in Fig. 9. It includes the keys, generally designated 50, of a conventional PC carriage keyboard. Besides the Escape key 51, it includes the following additional keys: Selector key 52 for selecting the number of lines in the display (e.g. one line or two lines); Left Aligned key 53; Center Aligned key 54; Right Aligned key 55; Size Font Change key 56; Font Selector key 57; Memory Store key 58; Memory Recall key 59; Program Done key 60; Program Done key 61; and Language Selector key 62. It further includes a Battery State indicator 65 to indicate the charge state of the battery.

While the invention has been described above with respect to one preferred embodiment, it will be appreciated that this is set forth merely for purposes of example, and that many other variations, modifications and applications of the invention may be made.



## CLAIMS

1. Liquid crystal display (LCD) apparatus, comprising:

5 a plurality of liquid crystal (LC) display elements carried by an LCD member and selectively energizable to produce a desired display, and electronic drivers actuatable to selectively energized the LC display elements to produce the desired display;

10 characterized in that said LCD member includes LC display elements having an inherent memory, a plurality of contact pads, and a plurality of electrically-conductive pathways connecting said contact pads to the LC display elements; and

15 further characterized in that said electronic drivers are carried by a separate programming unit having a holder for removably receiving and holding an LCD member to be programmed, an input device for selecting the LC display elements to be energized, and a plurality of pins to be brought into contact with said plurality of pads of an LCD member when received on said holder for selecting the LC display elements to be energized.

- 20 2. The apparatus according to claim 1, wherein said LC display elements define a rectangular matrix of vertical columns and horizontal rows; said contact pads being carried on the back face of the LCD member and including a pad for each vertical column of display elements, and a pad for each horizontal row of display elements.

- 25 3. The apparatus according to claim 2, wherein said back face of the LCD member includes a printed circuit board having an inner face facing the LC display elements, and an outer face carrying said contact pads;

the outer face of said printed circuit board including a first group of terminals electrically connected by conductive pathways to some of said pads on the back face;

the inner face of said printed circuit board including a second group of terminals electrically connected by plated-through holes to the remaining pads on said back face;

5        said first and second groups of terminals being electrically connected to the LC display elements on the front face of the flat panel.

4. The apparatus according to claim 3, wherein:

10        said first group of terminals on the outer face of the printed circuit board are electrically connected to corresponding terminals of the LC display elements by a first plural-line heat-seal connector strip; and

      said second group of terminals on the inner face of the printed circuit board are electrically connected to corresponding terminals of the LC display elements by a second plural-line heat-seal connector strip.

15        5. The apparatus according to claim 1, wherein said contact pads on the back face of the LCD member are arranged in a two-dimensional array.

6. The apparatus according to claim 1, wherein said input device includes a keyboard for manually selecting the LC display elements to be energized to produce the desired display.

20        7. The apparatus according to claim 1, wherein said plurality of pins to be brought into contact with said plurality of pads are carried by a carrier member which is selectively movable to an operative position bringing said pins into contact with the pads on the LCD member received in said holder, and to a retracted non-operative position spacing said pins from  
25        said pads.

8. The apparatus according to claim 7, wherein said carrier member is movable to its operative and retracted positions by an eccentric member rotated by a manual lever on said input device.

30        9. The apparatus according to claim 1, wherein said plurality of pins to be brought into contact with the plurality of pads are spring-urged pins.

10. LCD apparatus, comprising:

an LCD-based sign including a plurality of LC display elements having an inherent memory on its front face; and a plurality of contact pads on its back face, each contact pad being electrically connected to one of said display elements;

and a separate programming unit including a holder for removably receiving and holding an LCD-based sign to be programmed, an input device for selecting the LCD display elements to be energized, and a plurality of pins to be brought into contact with said plurality of pads of the LCD-based sign when received in said holder for selecting the LCD display elements to be energized to produce a desired display.

11. The LCD apparatus according to claim 10, wherein said LCD-based sign is a passive device devoid of a power supply and including a polymer-based LCD having an inherent non-volatile memory.

12. The apparatus according to claim 10, wherein said LC display elements define a rectangular matrix of vertical columns and horizontal rows; said contact pads being carried on said back face of the LCD-based sign according to a two-dimensional matrix and including a pad for each vertical column of display elements, and a pad for each horizontal row of display elements.

13. The apparatus according to claim 12, wherein said back face of the LCD-based sign includes a printed circuit board having an inner face facing the LC display elements, and an outer face carrying said contact pads;

the outer face of said printed circuit board including a first group of terminals electrically connected by conductive pathways to some of said pads on the back face;

the inner face of said printed circuit board including a second board of terminals electrically connected by plated-through holes to the remaining pads on said back face;

said first and second groups of terminals being electrically connected to the LC display elements on the front face of the LCD-based sign.

- 5 14. The apparatus according to claim 13, wherein said first group of terminals on the outer face of the printed circuit board are electrically connected to corresponding terminals of the LCD display elements by a first plural-line heat-seal connector strip; and

10 said second group of terminals on the inner face of the printed circuit board are electrically connected to corresponding terminals of the LC display elements by a second plural-line heat-seal connector strip.

- 15 15. The apparatus according to claim 10, wherein said input device includes a keyboard for manually selecting the LC display elements to be energized to produce the desired display.

- 20 16. The apparatus according to claim 10, wherein said plurality of pins to be brought into contact with said plurality of pads are carried by a carrier member which is selectively movable to an operative position bringing said pins into contact with the pads on the LCD-based sign received in said holder, and to a retracted non-operative position spacing said pins from said pads.

17. The apparatus according to claim 16, wherein said carrier member is movable to its operative and retracted positions by an eccentric member rotated by a manual lever on said input device.

18. A method of displaying information, comprising:

25 providing an LCD member with a plurality of LC display elements having an inherent memory on the front face of the member, and with a plurality of contact pads on another face of the member, each contact pad being electrically connected to one of said LC display elements;

bringing said contact pads into contact with a plurality of pins of a programming unit having a holder for removably receiving the LCD member, and electronic drivers for energizing the LC display elements; and

5                   selectively energizing said pins via said electronic drivers to select the LC display elements to be energized to produce a desired display of the information.

19. The method according to claim 18, wherein said LCD member is flat panel having a front face and a back face, said LC display elements  
10                   being arranged according to a two-dimensional matrix and being viewable on said front face; said contact pad being arranged according to a two-dimensional matrix and being carried on said back face.

20. The method according to claim 19, wherein said programming unit includes a keyboard, and said pins are selectively energized via said  
15                   keyboard and said electronic drivers.

21. The method according to claim 19, wherein the pins in the programming unit are normally in a retracted non-operative position to enable the insertion and removal of an LCD member with respect to the holder of the programming unit; said pins being moved to an operative position into  
20                   contact with said pads when the pins are to be energized to produce the desired display of the information.

22. An LCD-based sign having a front face and back face;

                  a plurality of LC display elements having inherent memory on said front face; and

25                   a plurality of contact pads on the back face, each contact pad being electrically connected to one of said display elements to permit said display elements to be selectively energized by drivers in an external programming unit for producing a desired display on the front face.

23. The LCD-based sign according to claim 22, wherein said LC display elements define a rectangular matrix of vertical columns and horizontal rows; said contact pads carried on said back face including a pad for each vertical column of display elements, and a pad for each horizontal row of display elements.

24. The LCD-base sign according to claim 24, wherein said back face of the sign includes a printed circuit board having an inner face facing the LC display elements, and an outer face carrying said contact pads;

the outer face of said printed circuit board including a first group of terminals electrically connected by conductive pathways on said outer face to some of said pads;

the inner face of said printed circuit board including a second group of terminals electrically connected by plated-through holes to the remaining pads;

said first and second groups of terminals being electrically connected to the LC display elements on said front face.

25. The LCD-based sign according to claim 24, wherein said pads are arranged according to a two-dimensional array.

26. The LCD-based sign according to claim 24, wherein said first group of terminals on the outer face of the printed circuit board are electrically connected to corresponding terminals of the LC display elements by a first plural-line heat-seal connector strips; and

said second group of terminals on the inner face of the printed circuit board are electrically connected to corresponding terminals of the LC display elements by a second plural-line heat-seal connector strip.

27. A programming unit for programming an LCD-based sign having a plurality of selectively-energizable display elements on its front face, and a plurality of pads on its rear face, each pad being electrically connected

to one of said display elements for energizing same; said programming unit comprising:

a holder for removably receiving and holding an LCD-based sign to be programmed;

5 an input device for selecting the display elements to be energized of the sign held in said holder; and

a plurality of pins to be brought into contact with the plurality of pads on the rear face of said LCD panel when received in said holder for selecting the display elements thereof to be energized.

10 28. The programming unit according to claim 27, wherein said input device includes a keyboard for manually selecting the LC display elements to be energized to produce the desired display.

15 29. The programming unit according to claim 27, wherein said plurality of pins to be brought into contact with said plurality of pads are carried by a carrier member which is selectively movable to an operative position bringing said pins into contact with the pads on the LCD member received in said holder, and to a retracted non-operative position spacing said pins from said pads.

20 30. The programming unit according to claim 29, wherein said carrier member is movable to its operative and retracted positions by an eccentric member rotated by a manual lever on said input device.

25 31. The programming unit according to claim 27, wherein said plurality of pins to be brought into contact with the plurality of pads are spring-urged pins.

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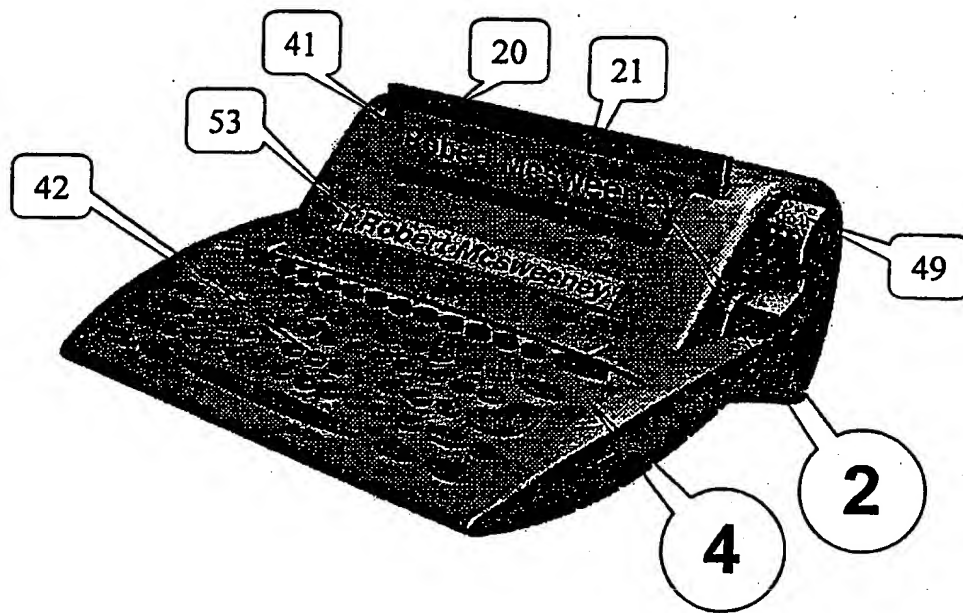


Fig. 1

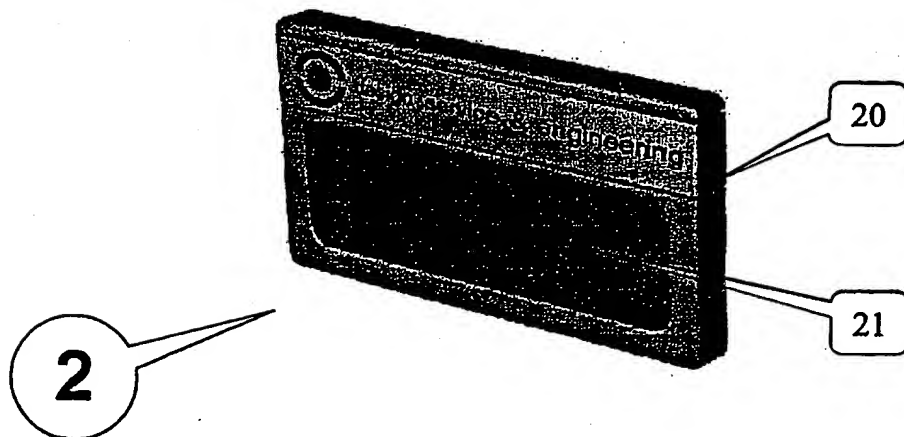


Fig. 2



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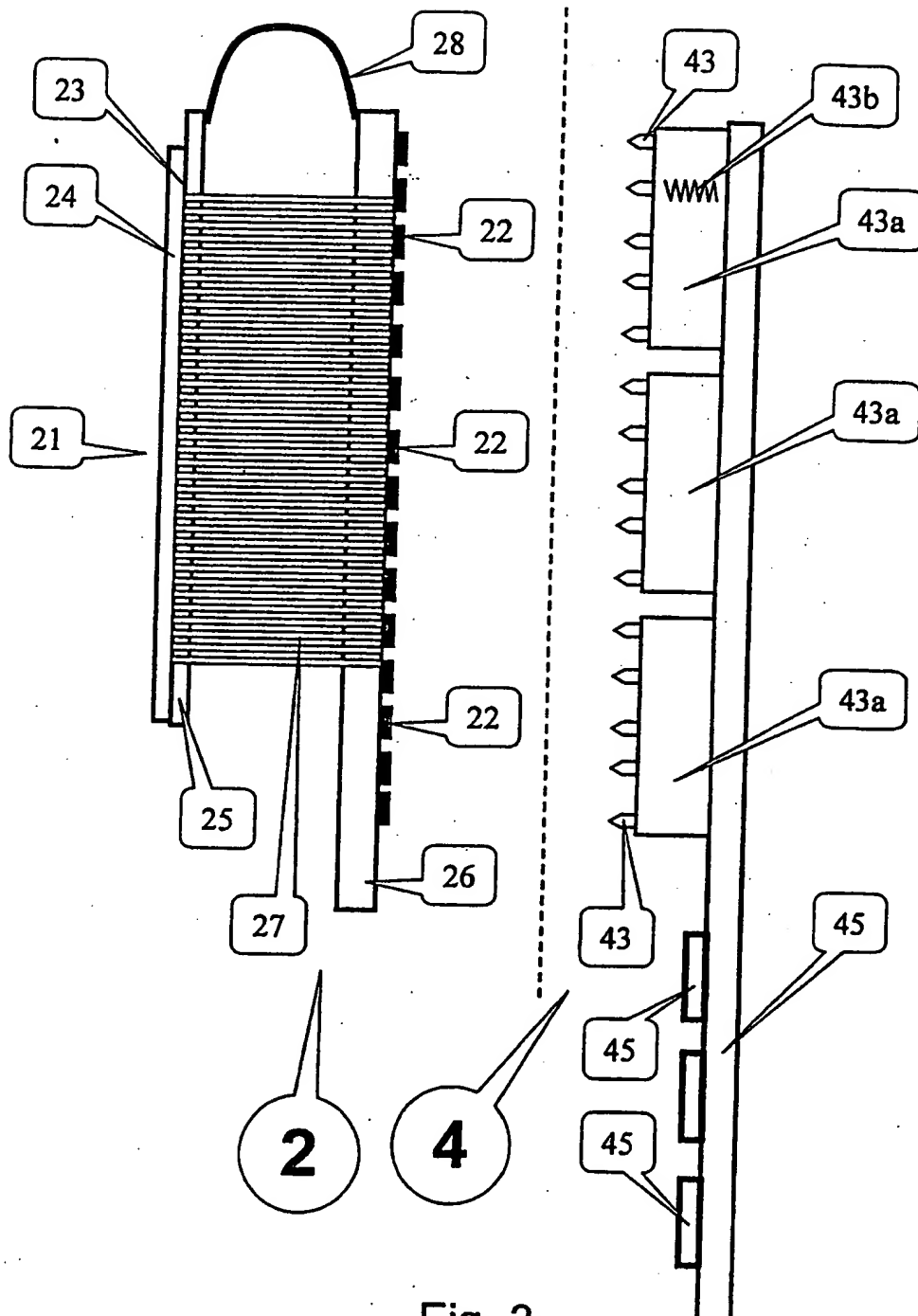


Fig. 3

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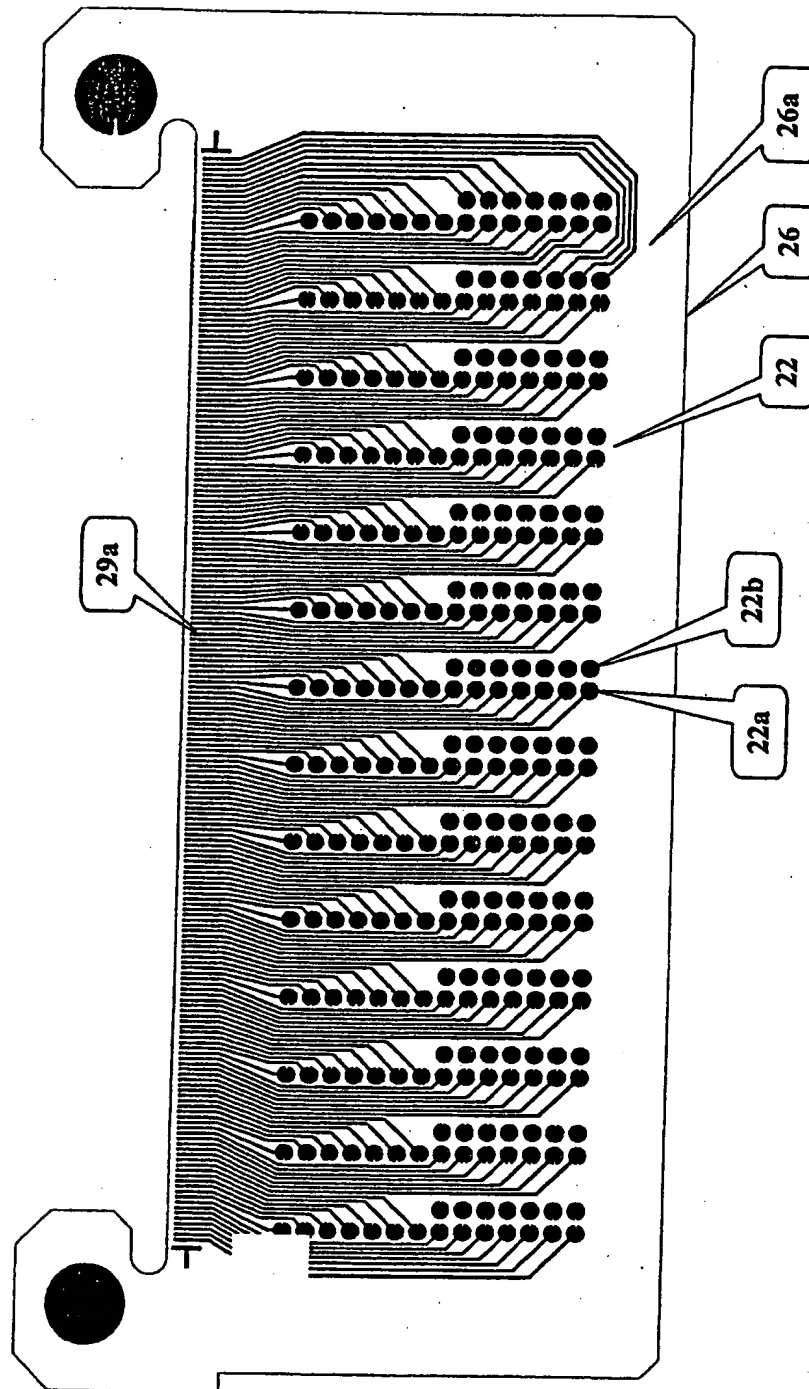


Fig. 4

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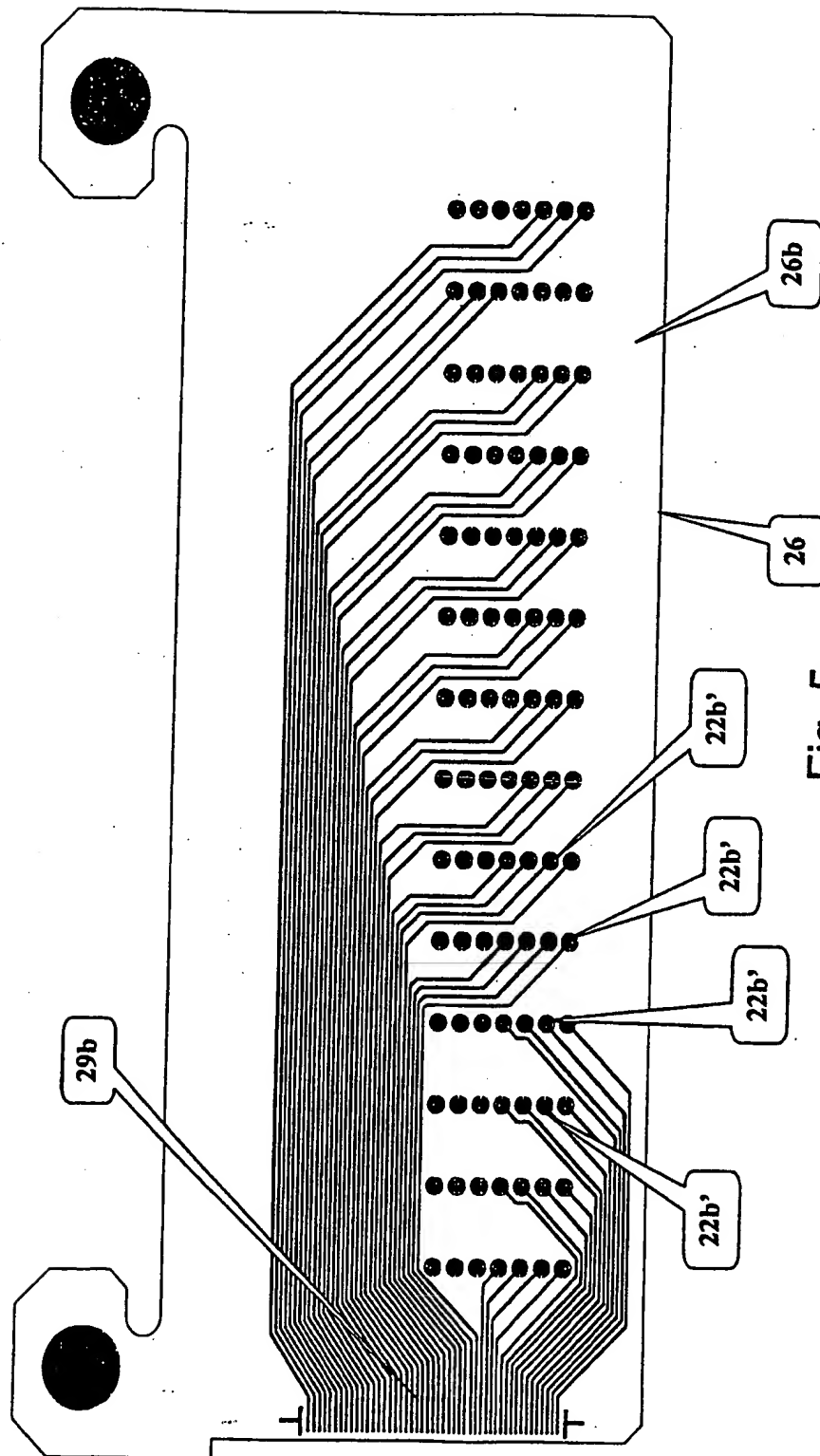


Fig. 5

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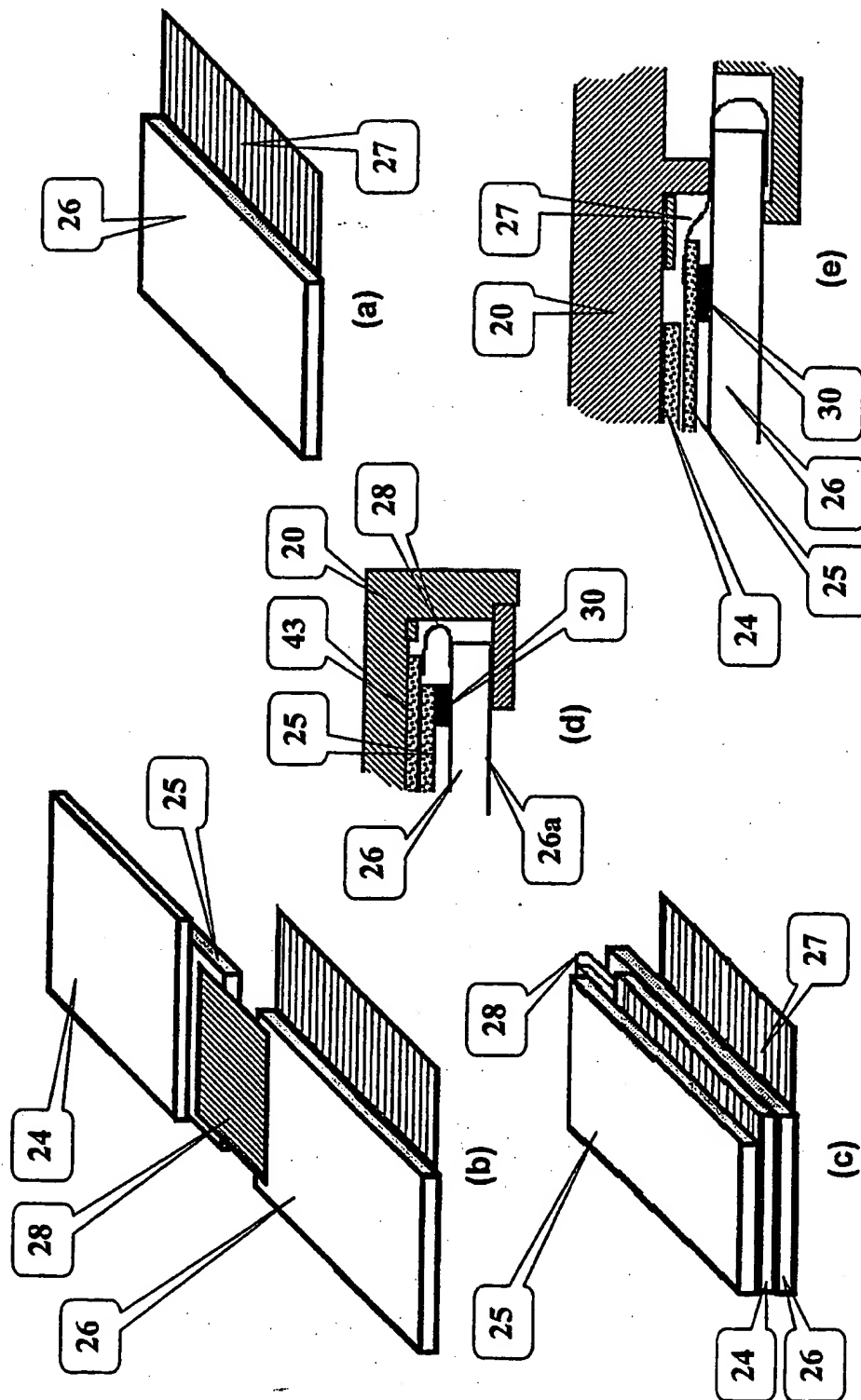


Fig. 6

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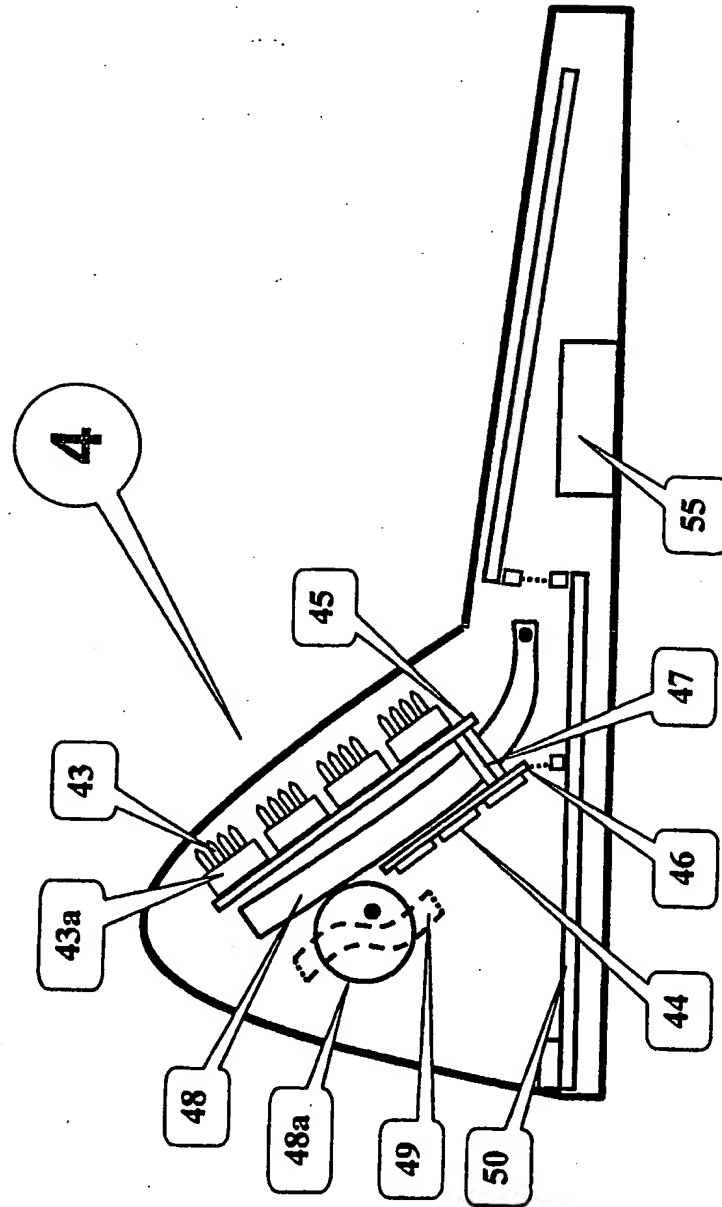


Fig. 7

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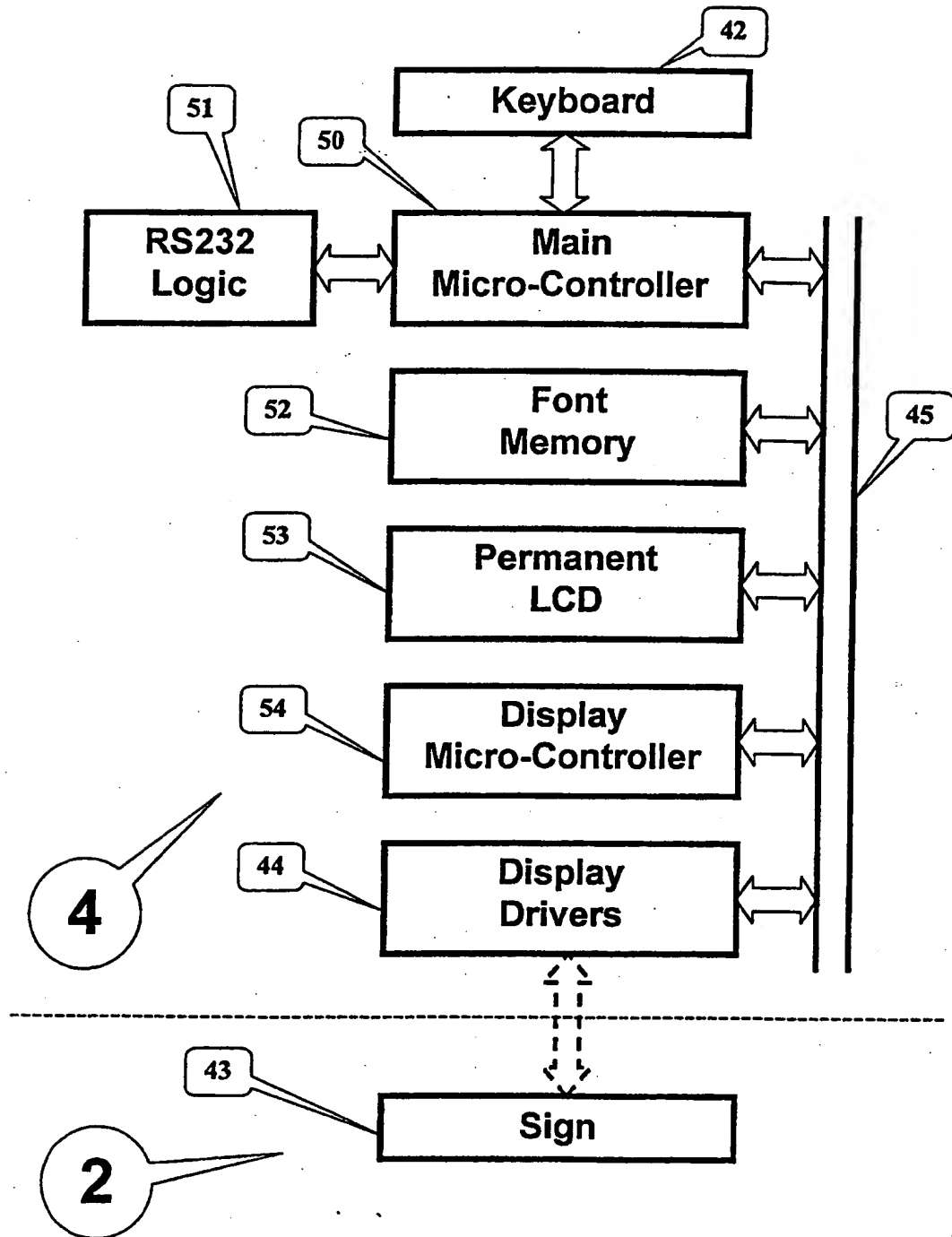


Fig. 8

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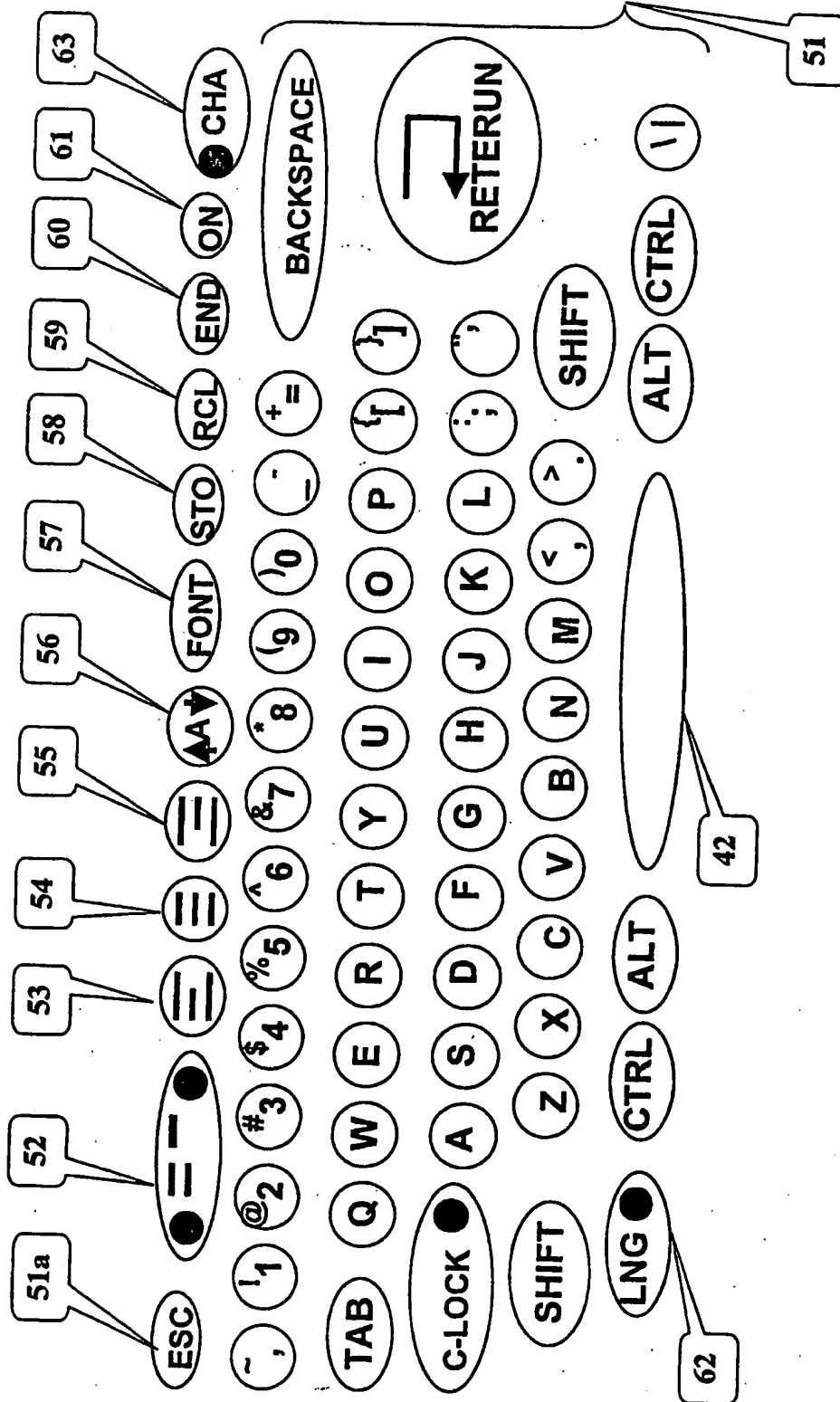


Fig. 9

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/IL99/00375

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : G09G 3/36

US CL : 345/87

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 345/87, 89, 90, 99

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
INTERNET

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WEST: LCD, Contact pads, Electronic Driver, Printed Circuit Board, Pins adj contact

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,724,463 A (DEACON et al.) 03 March, 1998, Whole Document	1-31
Y	US 5,235,451 A (BRYAN) 10 AUGUST 1993, whole document	1-31
Y	US 5,227,614 A (DANIELSON et al.) 13 JULY 1993, whole document	1-31

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
*A* document defining the general state of the art which is not considered to be of particular relevance	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
*B* earlier document published on or after the international filing date	*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*A* document member of the same patent family
*O* document referring to an oral disclosure, use, exhibition or other means	
*P* document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

26 OCTOBER 1999

Date of mailing of the international search report

30 NOV 1999

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